

**Final draft**

**Participatory Supply Chain Analysis of a High Value  
Spice, Javanese Long Pepper (*Piper Retro Fractum*  
Vahl.) in Takeo Province, Southeastern Cambodia**

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## **ABSTRACT**

The study entitled “Participatory Supply Chain Analysis of a High Value Spice, Javanese Long Pepper (*Piper Retro Fractum* Vahl.)” and was conducted at Ream Anduek commune, Kirivong district, Takeo province. The study aimed to define Dei-Phlei production system, to calculate economics efficiency of Dei-Phlei production, and to design the supply chain of Dei-Phlei production. All the actors involved in Dei-Phlei supply chain have been interview. The study is based on both primary and secondary data; primary data was gathered using questionnaire with farmers, traders, wholesalers and retailers. Dei-Phlei producers at Chamkar get higher net income than producers at home which resulting from the difference of land condition by comparing EE/wooden pole. The profit is dramatically increased from the second year of production. The major input costs are mainly spent on wooden standard, bamboo roof, cow-dung manure and labor. The supply chain of Dei-Phlei is very simple demonstration starting from producer (farmers), inside and outside collectors, middlemen, retailers, wholesalers and exporter. Producers can either contact the collector or bring the product to sell at market directly. There is a minimal added value on cost of Dei-Phlei which significantly passed over on cost of transportation. Therefore, farmers themselves should inquire additional information and technical practice relative to improvement of production.

**Keywords:** Dei-Phlei production, economic efficiency, supply chain, Takeo province

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## LIST OF ACRONYMS

\$	:	Dollars
%	:	Percentage
a	:	Are (measuring of land sizes)
BSc	:	Bachelor Degree
EE	:	Economic Efficiency
EE <sub>1</sub>	:	Economic Efficiency in 1 <sup>st</sup> year
EE <sub>2</sub>	:	Economic Efficiency in 2 <sup>nd</sup> year
EE <sub>3</sub>	:	Economic Efficiency in 3 <sup>rd</sup> year
Kg	:	Kilogram
Km	:	Kilo meter
Km <sup>2</sup>	:	Square kilo meter
L	:	Liter
NI	:	Net income
SPSS	:	Statistic program for social science
TC	:	Total cost
TR	:	Total return
UK	:	United Kingdom
US	:	United state

# **PARTICIPATORY SUPPLY CHAIN ANALYSIS OF A HIGH VALUE SPICE, JAVANESE LONG PEPPER (PIPER RETRO FRACTUM VAHL.) IN TAKEO PROVINCE, SOUTHEASTERN CAMBODIA**

## **INTRODUCTION**

### **1.1 Background**

Assisting rural smallholders to participate in the market is increasingly seen as a sustainable approach to tackling poverty. The involvement in integrated supply chains provides diverse opportunities for smallholders in remote areas, enabling them to be part of the market and thus generate income (Francesconi, 2009). Farmers are looking for a range of products that they can sell to generate income (C Wheatley & Woods, 2004). Rural smallholders need to recognize what kinds of commodities which respond to market demand within their locality, so they are able to produce efficiency. However, limited access to markets remains a key hindrance for successful development (Christopher Wheatley, Best, Peters, & Connell, 2004). Therefore, identifying opportunities for income generation is crucial for rural development.

Piper retrofractum (Baseline Long Pepper or Javanese Long Pepper) is known as ឆៃផ្លៃ (Dei-Phlei) in Cambodia (Wikipedia, 2015). It is commonly used as ingredients and traditional medicine called “Brambeykae” which is very useful for pregnant lady after delivery baby. It is also an important spice crop generally cultivated in the hill areas of Takeo province located in the Southeast of Cambodia, especially in Kirivong district. Moreover, it is considered as a significant source of income for this local people since they produce it mainly for sale besides doing rice farming which is their main income source.

### **1.2 Rationale**

In Cambodia the domestication of non-timber forest products and the sale of their harvest are in focus of rural development programs supported by government and foreign donors; they assist the rural population to improve their livelihood by diversifying their agricultural production system. Thus, the rural farmers are linked to markets by improving instructor and enable them to participate in economic development of the country and to generate cash income which can be used to ensure food security.

Data on national’s exportation of Dei-Phlei are not available. Yet, it is estimated to be cultivated by a number of Dei-Phlei-growing families in this area of the province selling to foreign markets due to its high value and it has a greater impact on smallholder farmers. Also, Cambodia mostly exports

Kampot's pepper (*Piper nigrum* L.) to Germany, Canada, the US, France, UK, Russia and Australia in fresh form and partly in traditional dried as black pepper.

### 1.3 Research Objectives

The overall objective of this study is to analyze the supply chain of Javanese long pepper (Dei-Phlei in Khmer, *Piper retrofractum* Vahl., Piperaceae), an important spice crop commonly grown in the hill areas of Takeo province, Southeastern Cambodia. Specifically, the study aims to define Dei-Phlei production system; to calculate economics efficiency of Dei-Phlei production; and to design the supply chain of Dei-Phlei production. The study seeks to answer the following questions:

1. What is the evolution of Dei-Phlei adoption?
2. How farmer use the three main production factors (Land, Labor and Capital)?
3. Where are the sources of capital?
4. What is the productivity of land, labor and capital of Dei-Phlei production?
5. Who are input suppliers and how it flow in to the production?
6. Who are the buyer and how Dei-Phlei flow out from the production?
7. Is there potential to promote production of cultivated Dei-Phlei?

### 1.4 Expected Outputs

The supposed results of this study would be published in peer-reviewed journal (at least 1 publication) dealing with purchasing and supply chain management (e.g. Journal of Supply Chain Management, Journal of Purchasing & Supply Management), and presented at international symposiums or conferences organized by scientific societies and federations. The outputs also includes one thesis from BSc student and a comprehensive report as well as economic data of the target villages.

### 1.5 Scope and limitation

The study was conducted in Kirivong district, Takeo province. The study focused on the important role of Dei-Phlei in farmers' livelihood by determining the income of each source of income. The opportunity cost of labor in their livelihood system is defined in order to compare the value added per labor. The mapping of supply chain action such as input suppliers, long pepper (Dei Phlei) producers, collectors, local traders and middlemen is analysis. The research also describes the long pepper cropping system in the area. The empirical data is based on a two-month field research that was conducted between March and May 2015.

## **METHODOLOGY**

### **2.1 Choice of the study area**

Takeo province is about 78 km away from Phnom Penh, situated in the Southeast of Cambodia and is divided into 10 districts with a land area of 3,562.70 km<sup>2</sup>. Kirivong district was mainly selected for study site where is potentially for Dei-Phlei production. The district borders Vietnam to the south, Koh Andaet and Treang districts of Takeo province to the east and north, and Toukmeas district of Kampot province to the west.

### **2.2 Research Component**

A survey of 40 households among 379 and 10 stakeholders in Ream Andaeuk commune, Kirivong district were randomly selected to interview using semi-structured questionnaires.

### **2.3 Data Analysis**

Microsoft Excel and SPSS were used for analysis in term of economics, information of householders such as sex of head of household, level of education, land use and so on. The descriptive static (frequency and percentage) was also included in the study.



## RESULTS AND DISCUSSION

### 3.1 Information of Sample respondent

This section provides the general information of sample respondents including sex, educational level, family members, age, source of land, and size of land (Table 1). Most of sample respondents (82.5%) are male household heads that commonly play important role in term of income generation, making decision, and taking high responsibility in the family. However, the women (17.5%) were also interviewed and most of them are widow as household head. As in Cambodian perception and culture, they always give the priority to husband for majority of decision making even though wife has higher income contribution to family.

Education is very important for adopt new knowledge or technique. Only those who can offer private schools or tutoring thus receive access to a complete national education and have greater opportunities to successfully graduate from public school (Ayres, 2000; Brehm & Silova, 2014). As a reflection of the study shows that almost half of sample respondents (40%) obtained at secondary school and none of them studied at graduate school. So, maximizing household income is essentially required an adequate education in different field of specialization, for instance, local famer of Dei-Phlei production would trained some technical program related to fields but they did not attend any program and their capacity of understanding the technical knowledge is very limited as well.

As a result, the study finds that the average of members is five members. However, in Dei-Phlei production, there were just only two members who take part in the whole operation of production. Head of family is a key person in Dei-Phlei production due to the rest members were involved in other occupations and study, especially factory and service sectors in nearby districts and Phnom Penh city. Turn to Dei-Phlei production, it does not require high labor intensive but only in planting stage is needed more labor than other stages. Therefore, it means the Dei-Plei production seems to perform as a suitable and favorable production for the local producers

Furthermore, almost one third of sample respondent who are contributed in Dei Phlie production is categorized such as between 40 to 50 year-old (25%), 51 to 60 year-old (23%), and 18 to 30 year-old (22%), respectively. These proportions could be highly provided the information that they are at full energy of labor force for production.

Source of land of local Dei Phlei farmers, half of them (55%) got the land from their family as heritage or bequest and forty-percent cleared public forest as illegal logging allocated close to the mountain area. The possessive of Dei Phlei land is private land ownership.

Lastly, two main types of Die Phlei productions namely Chamkar<sup>1</sup> and homestead<sup>2</sup> growers were significantly groups according to field survey and FGDs. Majority of Dei-Phlei producers at Chamkar (10%) were able to access more land than the others who grew at home. However, there are eighty-percent of households among producers at home have between 0.04 to 0.13 ha due to they could access to less space of land for clearing or expanding at mountain areas where located distance from village, so they have add more capital and transporting land in their production compare to the producers at Chamkar.

Table 1. Information of Sample Respondents

1. Sex of Head of family				
Sex	Number of household		Percentage (%)	
Female	7		17.50	
Male	33		82.50	
Total	40		100	
2. Education Levels of Head of Family				
Education Levels	Number of household		Percentage (%)	
Illiteracy	1		3	
Primary School	16		40	
Secondary School	16		40	
High School	7		17	
Total	40		100	
3. Number of member in household				
	Numbers of Family	Minimum	Maximum	Mean
Numbers of members per household	40	2	9	5
4. Group of Age of Member Contributed in Dei-Phlei Productivities				
Age of Members (years old)	Numbers of household		Percentage (%)	
Less than 18	2		3	
Between 18 to 30	14		22	

<sup>1</sup> Chamkar is determined in Khmer term refers to plot of land where it is grown multiple crop within several cycles a season and a year.

<sup>2</sup> Homestead or home yard is simply determined as a small plot of garden (s) of land surrounding home yard where Cambodian farmers usually grow vegetable or crop for home consumptions or small income generation.

Between 31 to 40		12		18		
Between 41 to 50		16		25		
Between 51 to 60		15		23		
More than 60		5		12		
Total		64		100		
5. Source of Land for Dei-Phlei Production						
Place	Number of household	Percentage of sources of land (%)				
		Heritage	Buying		Clearing Public land	
Chamkar	20	40	5		55	
Home	20	75	5		20	
6. Size of Land						
Kinds of Farms	Numbers of Farmers	Percentages of farmers with sizes of Dei-Phlei’s lands (%)				
		Less than 4ares	4ares to 13ares	14ares to 23are	24ares to 33ares	More than 34ares
Chamkar	20	0	40	35	15	10
Home	20	5	80	15	0	0

Source: Data Survey, 2015

### 3.2 Production Management

#### 3.2.1 History of Dei-Phlei







Dei-Phlei is a kind of crop that farmers always grow in the Chamkar (farm) and home garden behind their houses. Base on elder people in the village, Dei-Phlei had been existed in the area between 1954-1970 and it was grown at Chamkar and mountain. On the other hands, farmers left their Chamkar during Pol Pot regime (1975-1979). After that, they started growing again in 1995 because there is market demand. Presently, Dei-Phlei becomes more popular and being planted by farmer because of high demand and high price in the last few years. Moreover, they are expending their land for Dei-Phlei in order to get more income.

#### 3.2.2 Seasonal Calendar of Dei-Phlei

Dei-Phlei is a tropical herb which requires a good amount of sun shine and appropriate rainfall. Normally, farmers start clearing land from January to February in the fallow period right just after rice production in rainy season (Table 2). Regular schedules of cultural operations are needed for the plantation. Cultural practices involve weeding, mulching, trashing, shade regulation, and irrigation. The removal of old and dried shoots, leave and dried panicles should be taken up once in a year during March-May. For new plantation, overgrown plants are removed and destroyed first and land is cleared

of all weeds. The garden takes time from August-December even though during harvesting which is carrying out in from November-December.

Table 2. Seasonal Calendar of Dei-Phlei Productivity

Activities	Month											
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec
1.Land clearing and preparation												
2.Shade regulation												
3. Fertilizer application												
4. Planting												
5. Gardening												
6. Harvesting												

Source: Discussion with Key informant, 2015

### 3.2.3 Input Supply Situation

The quality of produce is depend on the input used and the methods adopted in its cultivation, processing, packing, storing, transportation ect (Hameedu M., 2014; Kumar, 2013). Therefore, great care is to be given for the production of agricultural products from seeding till harvesting. Dei-Phlei generally is grown along dead wood standards installed on an elevated plot of land in order to allow better rain water drainage. Its system is similarly to pepper production. In normal conditions, it should produce between 2.5 and 3 kilos per stand and can reach 5 kilos in exceptional cases (Benezech, 2007).

### 3.2.4 Capital and Credit Situation

Base on the result of survey, majority (75%) of Dei-Phlei farmers rely mainly on their own capital while some of households borrowed from their relatives (15%) and microfinance (10%) (Figure 1). With own capital would provide higher profit compared to borrowing from relatives, credit, and neighbor because of paying interest rate. However, there are some credit institutions accessing in the study site

and saving group is established by government in each village in order to provide capital with low rate for their agricultural productivities.

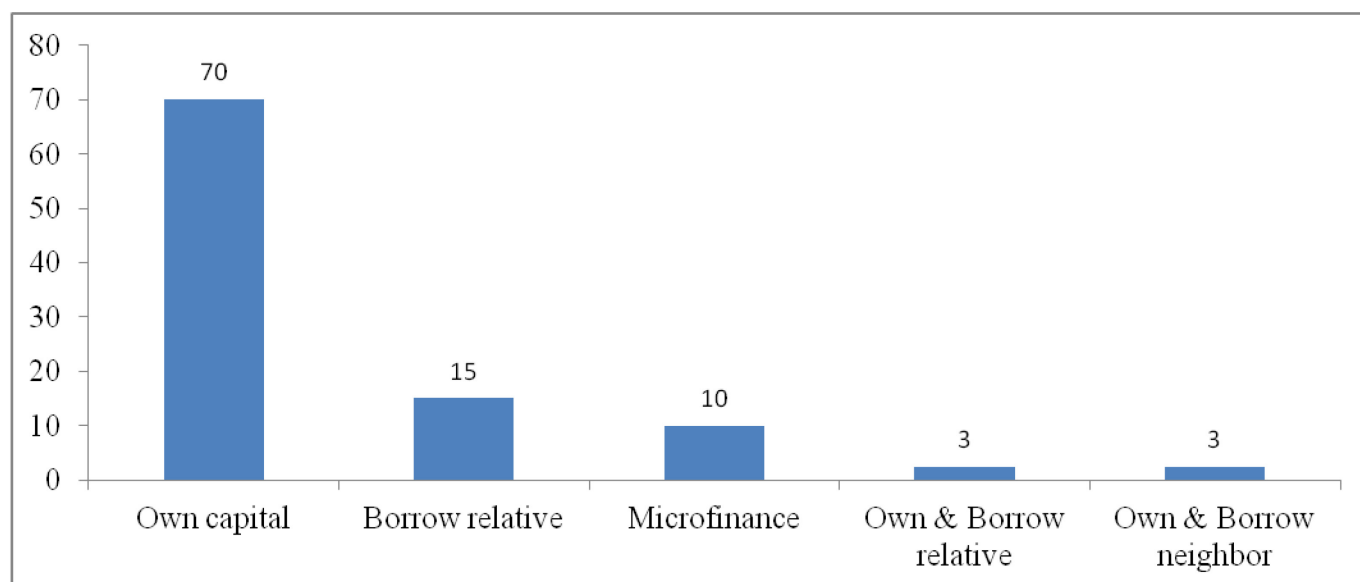


Figure 1. Source of capital (percent)

### 3.2.5 Wooden Standard and Shad Cover

The quality wooden standard as pole (Chhunlong) is a very important input among the others that leads to their frequent replacement. Twenty-percent (20%) of wooden pole are collected from the forest in their locality. Besides that, they buy from traders; there are exported from Kampong Spue province. Local people always contact directly to traders whenever they want to purchase the wooded pole. A wooden pole costs between 25,000 to 30,000 Riels. Replacing a pole is delicate operation as the vine is tightly attached to the standard. In case the operation damages the vine and leads to productivity loss (Benezech, 2007). Moreover, frequent purchase of wooden standard is an essential additional cost.

Coconut leaves is commonly used for shade cover laid on a bamboo roof and it is also necessary in dry season. Direct exposure to sunlight “burn” the pepper vine, then loses in productivity and eventually dies. The bamboo roof is the largest cost for our farmer according to result of study, and Kumar (2013) as well as Benezech (2007).

### 3.2.6 Irrigation

Irrigation is the most important for Dei-Phlei. Apparently, Dei-Phlei producer highly relies on raining (Figure 2). Access to water is certainly the number one problem of the farmers. During dry season

particularly from the month of December-January, no water available for irrigate the Dei-Phlei vines. They face difficulty to access the water sources; they could only use well and ponds. Unfortunately, most of Dei-Phlei farm at home often buy water and they are lack of equipments like water tank and hand tractor to transport the water. Hence, lack of water is the primary cause of lost yield in Dei-Phlei as well as pepper farms (Benezech, 2007). Normally, they irrigate twice per week for the first year and later on once per week.

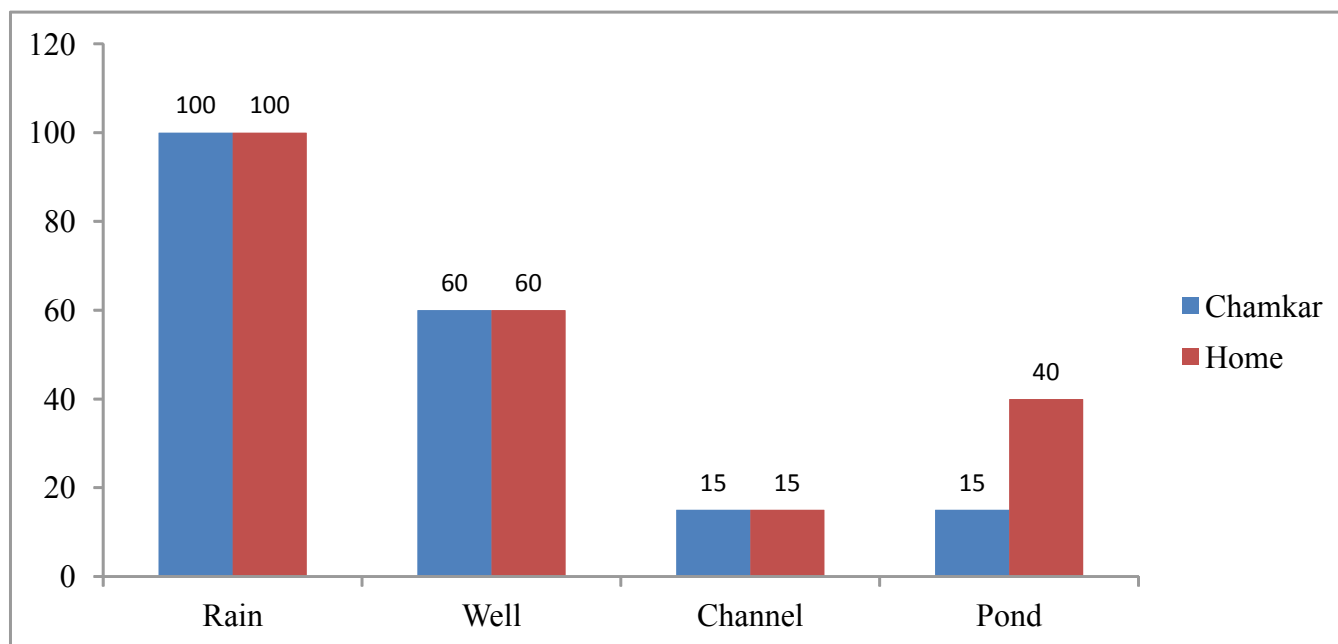


Figure 2. Source of water for Dei-Phlei (percent)

### 3.2.7 Plantation and Maintenance (Garden)

Dei-Phlei is a vine that grows along standards consisting of vertical poles. This vine originating from the tropical forests requires a hot and humid climate as well as a regulated exposition to the sun. Replicated today by grafting, a Dei-Phlei vine starts producing after 3 years. As same as to pepper, when 6 -7 years old, it reaches its maximum production and can then be 5 meters tall. A pepper vine can live for more than 30 years but its productivity starts decreasing after 15 years and is almost nil after 20 years. The result shows that half of sample respondents (50%) got their Dei-Phlei plant by replicated and grafting from their relative while 20 percent keep by themselves (Figure 3). In addition, plant protection is the main issue to avoid the pests and diseases.

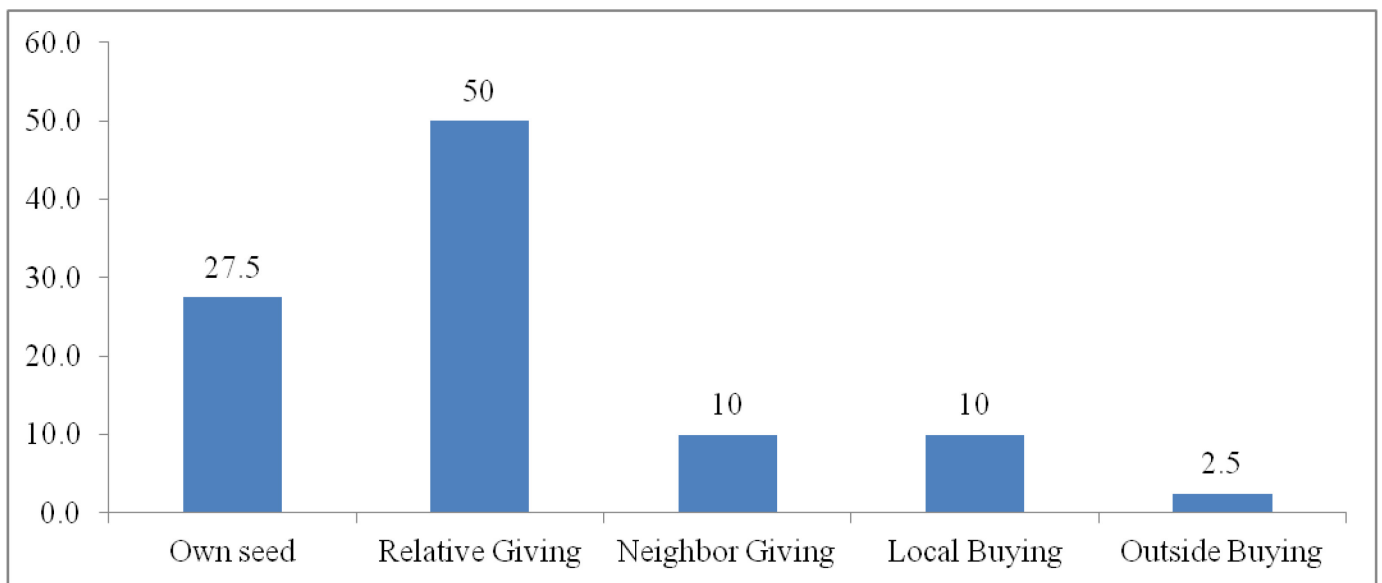


Figure 3. Source of Dei-Phlei plant (percent)

### 3.2.8 Nutrient Management

Fertilizer (cow dung) input is vital for the health of Dei-Phlei vine. Many of sample respondent as well as farmers do not own enough cow manure to cover the annual needs in fertilizer. In addition, some farmers always buy it from the others in their local; an ox-cart of cow dung manual costs 10,000 Riel and a hand tractor is 25,000 to 40,000 Riel.

### 3.2.9 Harvesting

Dei-Phlei starts bearing the fruit from the third year of planting. On maturity, the berries turn in to red color and they are harvested manually three to four times in every rainy season. With their harvesting, they use their own labors but sometime they hire the other in average two workers (include their labor and outsider). Generally in the locality, the labor cost of harvesting Dei-Phlei with other outsiders, they always calculate with the amount of petro which is 2000 Riel per petro (around 15kg per petro).



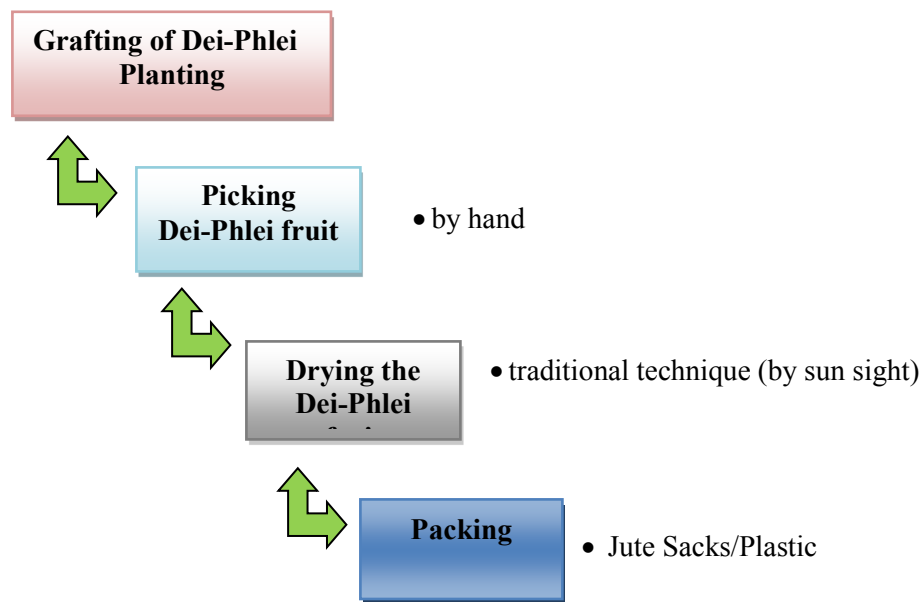


Figure 4. Production Flow of Dei-Phlei

### 3.2.10 Post-harvest Curing

After the process of harvesting the berries are dried in the drying yards, so they turn in to black color and loose moisture (Figure 4). They dried seeds are cleaned and are been stored by using net, plastic or gunny bags. This equipment is better than other thing which is very fast to make Dei-Phlei dry. However, farmer always face with the bad condition of weather which mean that they always get raining during drying.

### 3.2.11 Grading and Packing

No grading was followed at the farm level because there is no specific level from market. Moreover, they use sack in order to package their Dei-Phlei and store at their house, but normally collectors always arrive immediately after their Dei-Phlei dried.

### 3.2.12 Transporting

Base on the infrastructure in commune, Dei-Phlei production is linked with the market smoothly since the traders are able to collect from producers directly by their own motorbikes owing to the good condition of the roads that leads Dei-Phlei producers do not need too much time to transport their product to traders.

### 3.3 Economic Analysis of Dei-Phlei

The cost of production in first year mainly covers land preparation, pants, fertilizer, irrigation and other stuffs. Regarding to the result of this study shows that people who grow Dei-Phlei at Chamkar spend 4,239,646 Reil for 276 wooden poles in the first year. Labor is also the main actor for Dei-Plhei production. It indicates that most of Dei-Phlei producers mainly use their own labor. In fact, some producers employ workers during harvesting if the farms obtain number of wooden poles of Dei-Phlei berries. The workers are living in their locality as well as have less land or have not land for producing Dei-Phlei. Average of labor selling is about 20,000 Riel per day.

The farmers are profitable starting from second year of the production while in first year is negative profit. From second to third year, the positive net income is dramatically increasing from 1,800,000-2,900,000 Riel of Chamkar farm and 900,000-1,800,000 Riel of home farm, respectively (Table 3).

Table 3. Cost and net income of production per household

Cultivated Place	N.Chhunlong	Year	TC	TR	NI
Chamkar	276	1	4,239,646	1,239,250	-3,000,396
		2	1,969,201	3,835,714.00	1,866,513
		3	2,047,587	5,017,583.00	2,969,996
Home	183	1	2,773,325	617,900.00	-2,155,425
		2	1,307,850	2,267,917.00	960,067
		3	1,292,225	3,141,667.00	1,849,442

Source: Data analysis, 2015

Exchange rate 1\$=4,000 Riel

With the efficiency of production, the study calculated in one wooden pole of Dei-Phlei berries in each year of three years and the result determines that between farmers who grows Dei-Phlei at Chamkar get EE increasingly from first year to the third year which are  $EE_1 = 0.29$ ,  $EE_2 = 1.95$  and  $EE_3 = 2.45$  which farmers who grow at home get EE which are  $EE_1 = 0.22$ ,  $EE_2 = 1.73$  and  $EE_3 = 2.43$ .

Table 4. Net income of production per wooden pole of Dei-Phlei berries

Cultivated Place	Year	TC (Riel)	TR (Riel)	NI (Riel)	EE
Chamkar	1	15,373	4,493	-10,880	0.29
	2	7,140	13,908.00	6,768	1.95
	3	7,424	18,194.00	10,770	2.45
Home	1	15,155	3,377.00	-11,778	0.22
	2	7,147	12,393.00	5,246	1.73
	3	7,061	17,168.00	10,107	2.43

Source: data analysis, 2015

Exchange rate 1\$=4,000 Riel

### 3.4 Analysis of Supply Chain of Dei-Phlei

#### 3.4.1 Supply Chain Map

With the function in Dei-Phlei supply chain, farmers play a significant role in activities of planting, harvesting, drying and packaging (Figure 5). At the same time, there are two kinds of trading: trading I refers to local traders or collectors who collect the product from those producers and then transfer to traders at Phnom Penh and Kampot province. Trading II refers to merchants or wholesalers who receive the product that transporting Dei-Phlei by local collectors directly to them. The main role of wholesalers is to sale the product in Phnom Penh as well as export to abroad (Vietnam or China). There is very limited in support or facilitation in Dei-Phlei production for producers even though currently local authority pays attention on them such as facilitation on Chhunlong importing in to their local. However, the price of Dei-Phlei is still fluctuated in every year and the cost of input is also increased especially price of wooden pole.

Additionally, middlemen play role in collecting Dei-Phlei from producers. Base on key informants during discussion and survey, there are two middlemen in the commune and other two from outside (Tonloab commune, Kirivong district). Those middlemen often come to collect Dei-Phlei from producers almost every day during cultivating season. Surely, there are two main targets of wholesaler who

collectors in Kampot province and Phnom Penh. For the local collectors, one has sold to trader in Kampot province and Phnom Penh, and the other one sold to trader in Phnom Penh. With the transportation, one collector has his own car to transport Dei-Phlei directly to traders and other tree traders have not any vehicle to transport their production. However, they transport by taxi with charging in average 10,000Riel/sack with 60kg-70kg/sack.

Grafting pant of Dei-Phlei (leave) is the sub-product for Dei-Phlei farmers. Some of producers have sold their leave of Dei-Phlei to the other people from outside province such as Kampong Cham, Kampot, Pursat and Battambang provinces during 2013 and 2014 in order to test their land quality with Dei-Phlei since they want to grow long pepper in their local. Some of producers sold their leave of Dei-Phlei in average 100\$ to 200\$ in the last year for the outsiders which is 2,000 per leave. Otherwise, for the local buyers (their neighbors), they charge less than around 1,000Riel per leave.

### Supply Chain Map of Dei-Phlei

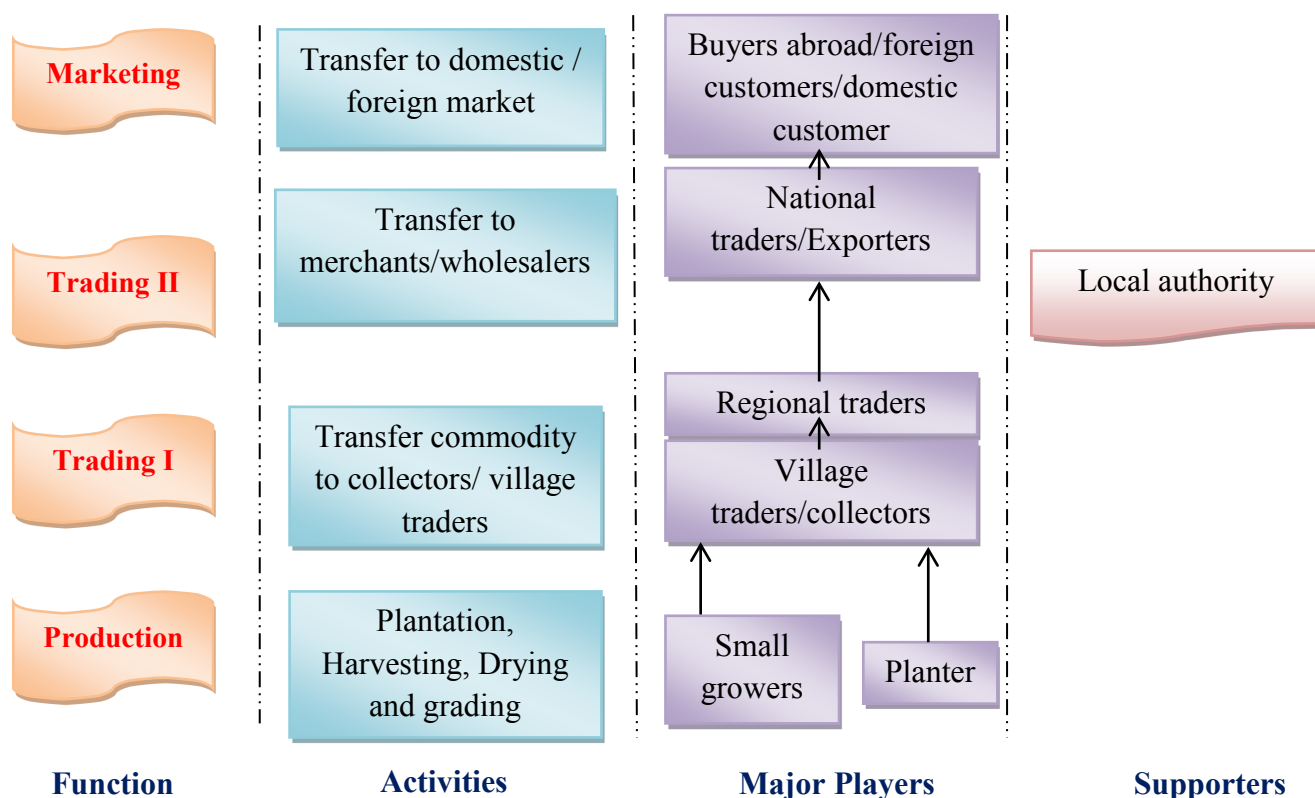


Figure 5. Supply chain map of Dei-Phlei

### 3.4.2 Supply Chain of Dei-Phlei

The supply chain of Dei-Phlei is presented in Figure 6. Farmers play a significant role to produce Dei-Phlei for supplying to the market. They have a big market because middlemen always collect their Dei-Phlei immediately whenever they harvested. Middlemen arrive immediately whenever producers contact them directly. On the other hands, the price of Dei-Phlei is not stable especially in recent years the price is varied up and down. With the current price of it, they can get between 22, 000 Riel/kg in the early of season and 17,000 Riel/kg in the end of season.

Additional value has mainly been added including of transportation. For example, local producer sells to collector at 30,000 Riel/kg, then when arrive in hand of wholesaler is 31,000 Riel/kg (added 1,000 Riel/kg of transportation cost). The big market of Dei-Phlei is in Kampot province and Phnom Penh. Regarding to the study did not get the specific data directly from those wholesalers. Depending on the result, one wholesaler sale Dei-Phlei in Phnom Penh and other one export to Vietnam.

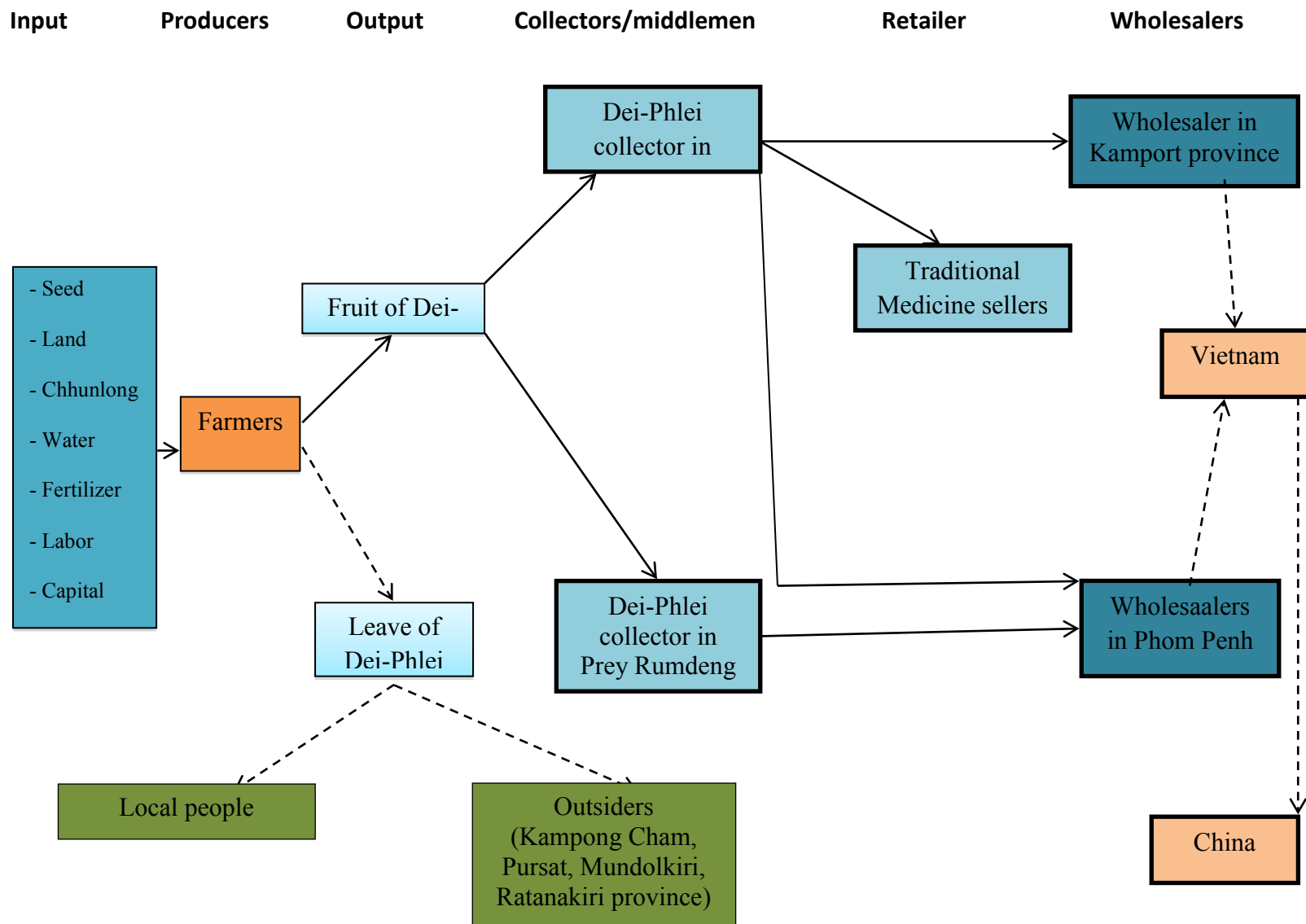


Figure 6. Supply Chain of Dei-Phlei

## CONCLUSION AND RECOMMENDATION

### 4.1 Conclusion

Dei-Phlei is one of major crops cultivated in Kirivong district south of Takeo province. Area of production and productivity also become improved and extended. There is possibility exist potentials for expansion of Dei-Phlie in the area. The cultivation is highly intensive family labor and it provides farmers with their own employment and regular income. However, Dei-Phlei producers still adopt low technique especially they still follow the traditional practices resulting low productivity.

Based on the economic analysis, Dei-Phlei producers at Chamkar get higher net income than producers at home which resulting from the difference of land condition by comparing EE/wooden pole. The profit is dramatically increased from the second year of production. The major input costs are mainly spent on wooden standard, bamboo roof, cow-dung manure and labor.

The supply chain of Dei-Phlei is very simple demonstration starting from producer (farmers), inside and outside collectors, middlemen, retailers, wholesalers and exporter. Producers can either contact the collector or bring the product to sell at market directly. There is a minimal added value on cost of Dei-Phlei which significantly passed over on cost of transportation. Some constraint such as lacking of water, price fluctuation, lack of capital, insufficient of manure as well as poor techniques leads Dei-Phlei production at low productivity and less profitable.

### 4.2 Recommendation

Farmers themselves should inquire additional information and technical practice relative to improvement of production. Problems of cultivation are related to a general lack of knowledge, so farmers should provide practical knowledge in plant protection and pest management. Beside government and non-governmental organizations should encourage farmers not only technical assistant but also some compensation for ecosystem services to who produces organic Dei-Phlei product. Market and price adjustment should be take into consideration from all relevant stakeholders especially government.





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